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Meetings

October 10, 1941

REPORT ON SUPERVISORS' TRAINING-INSPECTION TRIP CARIBOU NATIONAL FOREST

September 1-6, 1941

By
Lincoln Ellison
Intermountain Forest & Range Experiment Station

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TABLE OF CONTENTS

	Page
General description	1
Highlights of trip	4
Possibility for a range natural area	4
Use of range survey data	6
Judgment of range utilization	11
Danger in the use of "indicators"	12
Environment as a phase of fertility	15
Relationships between grazing and range recovery	17
Ways in which Research can help Administration	20
Comments by supervisors	20
Provision of information: basic knowledge	22
Provision of information: practical studies	24
Provision of technical assistance	28
Encouragement of desirable attitudes	31
Ways in which Research can profit by closer collaboration with Administration	33
Utilization of information from old study plots	33
Planned experiments	35
Orientation	37

GENERAL DESCRIPTION

As part of a Regional training program with the object of standardizing judgment of range conditions, the following men participated in the inspection trip to be described in this report: Supervisors Arentson, Benedict, Gurr, Price, Stewart, Taylor, Torgerson, Varner, and West; Dean Dunn of the Utah State Agricultural College and Dean Jeffers of the University of Idaho; Favre, Moncrief, and Phinney of the Regional Office, Birkmaier of the Washington Office, and Ellison of the Intermountain Forest and Range Experiment Station.

The trip began at Montpelier and progressed in a general northerly direction to the Fall Creek R. S. Route and stops followed only generally the tentative schedule in Favre's letter of July 30. The ground covered is shown by solid red lines on the accompanying map. Broken red lines indicate such travel made on the preliminary trip, August 29 and 30, by Varner, Phinney, and myself, as was not retraced during the main trip. It will be noted that the trip was confined mostly to the western side of this division of the Caribou and that the roads, except for a stretch along the ridge between Brockman R. S. and the head of Fall Creek, hold pretty closely to

Fig. 1.- The group in Caribou Basin, September 4. Left to right: Phinney, Gurr, Favre, West, Taylor, Moncrief, Arentson, Benedict, Torgerson, Varner, Price, Stewart, Ellison, Jeffers, Birkmaier. Dunn has left the party at the time this picture was taken. L.E. 674

the valley bottoms. It cannot be said, therefore, that we obtained a true cross-section of the Forest. To have gotten such a cross-section we should have had to look into the rougher, more sharply dissected country in the eastern half of the Forest, which could have been done only afoot or on horseback at the expense of considerably more time.

The topography of the Caribou is predominantly gentle and rolling. There are high ridges and steep slopes at the southern end,

Fig. 2.- Topography of the Caribou N. F. is mostly gentle, and the characteristic type is mixed sagebrush and herbaceous plants. In this view on the Bridge Creek cattle allotment the points and southerly slopes are still eroding rapidly, while the broad ridgetops and northerly slopes seem to be pretty well stabilized. L.E. 668

and some rather rugged country in the northeastern part, but by and large the Forest is easily accessible to livestock. The principal vegetal type is sagebrush-grass. There is but little timber, which is mostly lodgepole pine and aspen, and this occurs principally on the eastern side of the Forest. The chief value of the Forest is evidently in grazing, for neither watershed, timber, nor recreational values are of anywhere near equal rank with it.

HIGHLIGHTS OF TRIP

Possibility for a range natural area

From all I could learn, Bear Island in the midst of Grays Lake is an area which has never been grazed by livestock to any appreciable degree. I was told that the "lake" is in reality a swamp, too soupy to be crossed on foot except when frozen in winter and too mucky to be traversed by boat. However, the map shows a bench mark at the eastern end of the island, at 6,660 feet. Supervisor Varner and Ranger Peterson say that a few cattle are known to have strayed onto the island during the winter, but they believe it has never been grazed during the growing season.

If this be true, Bear Island might make a very valuable natural area containing range types which are probably nowhere else obtainable in such a virgin state. Isolated as it is, the island should be free of such introduced species as cheatgrass and Russian-thistle, for it is not subject to the bordering population pressures that a natural area in the midst of grazed range would be subject to. If the island has been separated from the mainland sufficiently long, there may be taxonomic variations in the fauna and flora which would make it of even more general scientific value.

From the map I judge the land area to be about 530 acres. As well as one can make out from the mainland the southerly aspects seem to be vegetated with sagebrush and scrub, the northerly aspects with aspens and conifers. The visibility at the time was poor and as we were always at some distance from the island I am unable to give any better description of the vegetation.

Fig. 3.- Bear Island from the east, looking along its main axis. The light area represents hayfields, the dark areas, continuous with the island, is swamp. The low-lying hill in front, surrounded by hayfields, is Bishop Island. Bishop Island is undoubtedly grazed, whereas it is said that Bear Island is not. L.E. 671

Fig. 4.- A more nearly broadside view of Bear Island from the southeast. L.E. 672

The need for natural areas is so acute that I believe investigation of this island should be made as soon as possible. Presumably it supports range types which, because of the easy accessibility of all the surrounding country, nowhere else approach anything like a virgin state. Thus the island may well hold the key to land management in this locality. These remarks are mostly conjecture: the area must be studied before we can appreciate its actual value. If the island should prove to be really desirable for a natural area, then prompt and vigorous action should be taken to protect it. In time the swamp will undoubtedly be drained for hayfield and pasture, and then the island will be overrun with grazing animals. Before this happens a suitable buffer strip should be fenced off all around the natural area. At present, however, if the island is as inaccessible as I am led to believe, it will be unnecessary to incur fencing costs.

Use of range survey data

One of the most valuable features of the trip was the use made of past range survey records. Surveys of the Caribou were made in 1914 and 1927, and type writeups from these surveys were available during the trip for comparison with present conditions. The procedure followed was to select a type which could easily be identified and then, standing in that type, to read the plant composition as given on the old type writeup sheets and to discuss changes. The value of these discussions was increased because members of the group had taken part in the surveys, Favre in the earlier and Phinney, who led the discussions, in the later one.

Fig. 5.- Discussing changes in plant composition as revealed by old type descriptions, Morgan Meadows. In this meadow type grasses have decreased and tarweed has increased since 1914. L.E. 670

The method is open to criticism — estimates are rough, it is difficult to locate the exact part of the type which may have most strongly influenced the early estimates, there are misidentifications, methods are not always uniform, and so on. Yet in many instances the differences were sufficiently great and were supported by enough evidence on the ground, so that there could be no doubt but that they were real. The technic needs to be refined and systematized before this method can be a good ecological tool, but it clearly has possibilities of great value. I have been interested in

differences in type description given by early and recent range surveys on the Manti. My comparisons were made in the office, however. The experience gained on this trip shows that the best possible understanding of changes can be obtained only on the ground.

Among the more clear-cut changes since the early type descriptions were made were: (1) invasion of dandelion in Dry Valley (Fig. 6), (2) decrease in grass and increase of tarweed in Morgan Meadows (Fig. 5), (3) change from a "weed" to a sagebrush type in Fall Creek (Figs 7 and 8), and (4) the invasion of conifers into sagebrush-weed range (Fig. 9). In the last two examples there were plenty of indications

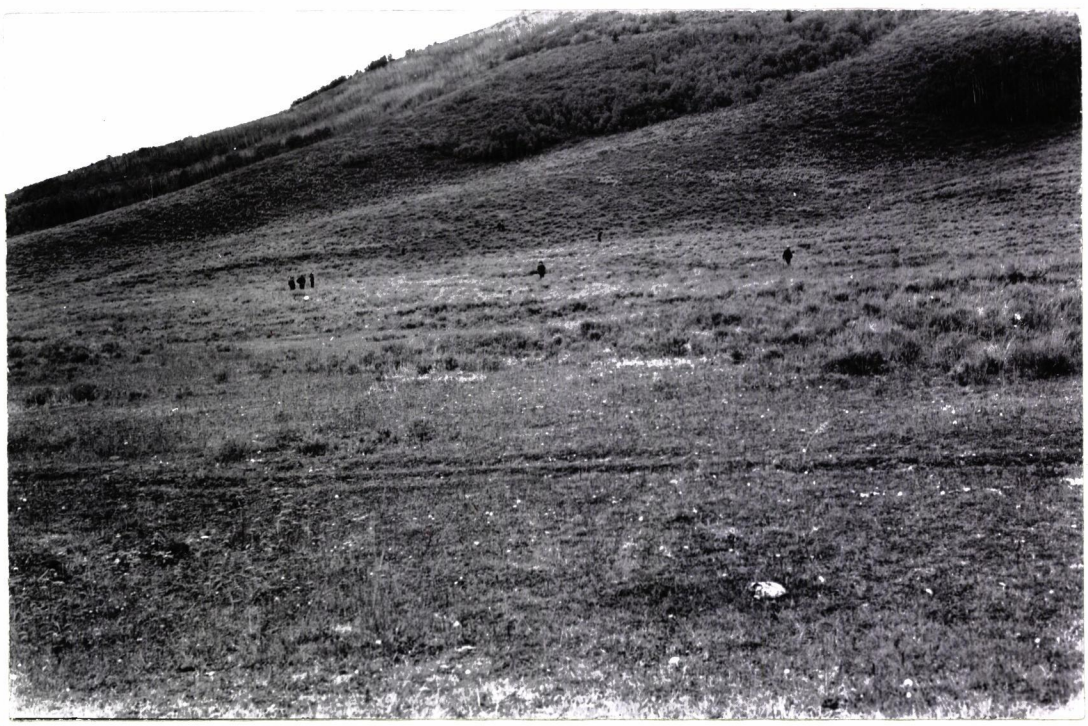

Fig. 6.- The group examining range conditions in Dry Valley. Type descriptions show that dandelion, now a conspicuous component of the vegetation, was lacking at the time the range surveys were made. L.E. 663

Fig. 7.- This sagebrush range in Fall Creek was typed in 1914 as a "weed" range with 40% "weeds" and only 10% sagebrush. Wyethia amplexicaulis (dark leaves at left) made up 20% and Lupinus made up 10% of the total cover. L.E. 680

Fig. 8.- A close-up of the ground surface in Fig. 7 which may explain why the type has changed to sagebrush. On the upper slopes and ridges marked soil erosion is evident. L.E. 681

Fig. 9.- Ridge about 5 miles north of Brockman R. S. Ridgetop is eroded to rock pavement supporting a rather dense stand of Agropyron and Stipa. Fringing this type, in an area of apparently deeper soil, is a broken band of Elymus. Islands of Elymus appear as light patches on the sagebrush slope. Note invasion of firs from the right. In 1914 the area at extreme right, now covered with timber, was characterized as a weed type. L.E. 679

on the ground as to how things had been going, but the confirmation from the type descriptions assisted greatly in visualizing the changes that had taken place. The men were especially impressed with the invasion of sagebrush range by conifers, and it is likely that had the type writeup been lacking this rather evident change would have gone unnoticed by the group.

Judgment of range utilization

The group recognized that range utilization consists of more than the harvesting of plants, that soil disturbance, site conditions and season are important factors which must be integrated with the cropping of forage in arriving at a realistic estimate of range use. Yet, while the group had this general knowledge, they lacked specific knowledge as to how the integration should be performed, and so they were unable to apply such knowledge as they had. They were thus forced to apply the method they knew to be inadequate -- utilization as revealed by the height of stubble. Here, it seems to me, is a place where Research could be of very great help.

The lack of a satisfactory base for expressing degree of utilization of the individual plant -- whether to consider utilization of all the plant as 100 percent, or whether to consider utilization of all usable herbage as 100 percent, either of which is involved in difficulties -- led the group to agree that expression of utilization in percent is undesirable. The group agreed that such terms as "underutilized", "properly utilized", and "overutilized" are preferable to definite figures because they are less liable to misinterpretation and permit the integration of site factors in the estimate. Thus, a valley bottom range from which 20 percent of the herbage has been eaten, might be characterized as "underutilized", whereas if the herbage on a steep southern exposure were cropped to the same extent, the range might well be classed as "heavily overutilized".

These seem to me to be points which the Utilization Standards project should investigate thoroughly, if they have not been investigated already. The fact that a group of experienced, practical men should reach virtual unanimity on so controversial a subject as range utilization seems to me to be of particular significance at this time when the Utilization Standards work program is being organized.

Danger in the use of "indicators"

I have had the feeling for some time that we in the Forest Service may be prone to simplify problems and probable causes to such an extent that we are led to erroneous conclusions. No doubt this tendency results in part from the fact that our problems are difficult because they are ultra-complex, and in consequence perhaps we tend to create a "defense mechanism". That the problems are so complex, however, should be a warning against the likelihood of finding single causes. A case in point is the seizing of single "indicators" and pushing them beyond the point where they are really indicative. I do not inveigh against the use of indicators as such, providing they are all taken into account together, but the more an indicator is isolated the more dangerous it becomes as a guide.

I thought I could detect this tendency in the group. For one thing, some of the men, especially in the early part of the trip, seemed to feel that the degree of current utilization was in itself a sufficient indicator of range condition. This opinion naturally led to an over-optimistic view because of the favorable season. However, by the time the trip was over I believe there was generally

more of a tendency to examine the whole complex of indicators. As another example, we were one day on a badly eroded ridge which, nevertheless, supported a rather dense stand of wheatgrass. "Here," someone stated, "is a wheatgrass type, the climax. Should we not therefore conclude that the highest stage of development has been reached, and the range is OK?" It is not my purpose to argue whether the particular type was or was not a vegetal climax: the plain fact was that the soil and micro-environment were far from climax in nature, and that the tendency was to overlook them. Again, we saw a sagebrush slope on which young conifers were becoming established. On this basis alone it was suggested that the range must be maintaining itself and improving, since it was progressing toward the conifer climax. (Parenthetically I should perhaps note that grazing may be an important factor in promoting invasion by conifers.)

We had two very striking illustrations of the fact that severely overgrazed range may show no sign of pedestalling. One was a cheatgrass type on some private land at the head of Fall Creek. From this the topsoil had been scoured completely. Nearby range, grazed less severely, was lumpy with pedestals, and the fact that excessive erosion had taken place was clearly apparent. Yet without this comparison one might have assumed the smooth-surfaced cheatgrass range to be in fairly good condition. The other example was along a driveway in Caribou Basin. Away from the driveway the ground was all bumps and hollows, but on the driveway itself there wasn't so much as a single pedestal. In this case, it seems evident that erosion on the driveway

Fig. 10.- One of the Elymus islands shown in figure 9. Such islands are encountered frequently in the northern half of the Forest, often with mountain yellowbrush as a conspicuous component. In this instance the dark shrubs are snowberry. The reason for the presence of these islands is not clear. They occupy slight mounds which seem in many instances to be places where soil has been thrown up by burrowing animals. L.E. 678

is so rapid and so complete over the whole surface that pedestals don't even get a chance to form.

It is possible that Research, in order to popularize its findings and put them into practice, may unconsciously encourage the tendency I spoke of first in this section. We should, of course, do the reverse; we should consciously strive to create an appreciation not for a particular indicator, but for the complex of indicators that exist under any condition.

Environment as a phase of fertility

It was the expectation of the group that I would lecture on soils, demonstrating the signs of fertility and infertility, pointing out the limits of the various horizons and indicating the degree of loss as a result of accelerated erosion. I did not attempt to do this in detail because I could not with any authority, but I substituted a somewhat different viewpoint. I do not wish to minimize the value and desirability of a fertile soil, and yet there are other factors beside fertility, as the term is generally understood, which affect productivity and especially establishment. Possibly emphasis has lain a little too heavily on fertility already, until the layman has adopted a fatalistic attitude: if you have a topsoil, good; if you haven't, that's too bad, but what's lost is lost and nothing can be done about it. There thus develops something of a tendency to shrug off responsibility for badly eroded areas, for this viewpoint disposes too easily of the problem. The viewpoint might be developed into a seriously mistaken philosophy of management to such an extent that, since much of our mountain range lacks an intact topsoil and is hence not up to maximum productivity, land managers should never expect more of it. That an area hasn't plants because it hasn't topsoil is true, of course; but that it hasn't topsoil because it hasn't plants is even truer.

It has been my observation that mountain soils will grow almost anything, no matter how badly they have been eroded, provided surface conditions are right. The fact that surface conditions are usually not right seems to be more important than the soil's particular level

Fig. 11.- Sloping ground in Diamond Valley upon which vegetation is slowly regaining a foothold after adjustments in stocking. Rapid erosion and the southerly exposure are probably the principal deterrents to seedling establishment. L.E. 665

Fig. 12.- Level ground in Diamond Valley near the slope shown in Fig. 11. Serious depletion is suggested by the hummocked, dead sagebrush and exposed roots, but reestablishment of vegetation is taking place much more rapidly than on slopes. L.E. 666

of fertility. We saw two examples on the trip. One was a gravel pile near a well in Dry Valley, certainly a primitive soil. Yet, because some water occasionally splashed onto the gravel from the action of the pump rod, the pile supported some fine large bunches of timothy. Again, we saw a reseeded area on Whiskey Flat, rolling sagebrush-grass range with a number of knolls on which sheep had bedded in years past to such an extent that all the soil from them had been lost. At present the surface of the knolls is nothing but rotten shale with no visible organic content. On such harsh sites as this the seeded smooth brome had taken hold, but only in the furrows made by the ripper when they followed the contours. There was none on the spaces between furrows. The evident explanation is that the furrows had made it possible to accumulate enough moisture to support the plants, whereas the environmental conditions of the interspaces would not permit establishment.

Some of the Great Basin quadrats strongly suggest the importance of environmental factors other than soil fertility in promoting the establishment of vegetation. This I have gone into elsewhere.

Relationships between grazing and range recovery

If a range is discovered to be in bad condition the cure that is first prescribed is to lessen the intensity of grazing or even to eliminate it. In many cases this remedy has proved effective but in others it is conspicuously ineffective. I know of one area, a self-contained watershed, which has continued to erode excessively for 25 years, even though it has been ungrazed or grazed but very lightly during this time.

One might make analogies with a ball on an incline. Suppose we say that pushing the ball up the incline is analogous to heavy grazing and the vertical height attained is a measure of the degree of depletion. Observing that the degree of depletion is increasing we cease pushing the ball -- we take the stock off the range -- and immediately the ball begins rolling down the incline. Now the degree of depletion is lessening -- that is, the range is improving -- as an immediate consequence of releasing the pressure.

If we adopt the opposite convention and say that movement down the incline corresponds to heavy grazing and the height lost is a measure of the depletion, we have quite a different situation. Here if we start the ball to rolling -- that is, we graze the range -- we may start a process which we cannot stop. So far as management is concerned, we are helpless and cannot hope to see an end of the depletion until it has run its course.

Our philosophy of management leads us to consider grazing in the light of the first analogy; yet conditions favorable for parallelism with the second are by no means uncommon. It must therefore have a place in our thinking also. I do not mean to say that stock should not be removed from a depleted range. While such removal may not result in an immediately visible change for the better, no doubt it gives the range a chance to improve if it will. What I wish to emphasize is the danger in the common assumption that removal of stock will result in corresponding improvement. This assumption holds good only under certain specialized conditions, conditions which do not prevail at all on some mountain ranges. Hence the mountain land manager must

not allow himself to believe, as he often does believe, that having cut the stocking his job is done and the rest is up to nature. Cutting the stocking may be only the beginning of the real job of range reconstruction.

During the trip we frequently visited range which showed great improvement. Some looked so good that some of the men were ready to recommend an increase in stocking. Yet on some of these same areas it was still to be observed that the soil was slipping away too fast — obviously much faster than it was being made. It therefore seems evident that improvement in soil quality, at least at the surface, lags markedly behind improvement in the vegetation.

These considerations lead one to wonder how much indirect damage is likely to be done by grazing as compared with its direct effects. By "indirect" damage is meant processes which may be begun by overgrazing but which seem to continue independently. Once these processes are set in motion, does further grazing of even light intensity accelerate them? In order to inquire into these questions it seems that we first should know in detail the factors which operate to make the range parallel the first or the second analogy discussed above.

Fig. 13.- Overgrazed bottom in Home Canyon. Even the snowberry bushes show the effects of too-heavy use. Cattle hang in the bottom until forced by lack of feed to graze the slopes. The principal herbaceous vegetation is knotweed and Canada thistle. L.E. 659

WAYS IN WHICH RESEARCH CAN HELP ADMINISTRATION

Comments by supervisors

I asked the group specifically how Research could be of the most help to Administration. One opinion was that more of the "practical" side of research -- e.g. reseeding -- should be stressed. Another opinion was that we should investigate the effects of soil composition on the forage value of range plants. Another opinion was that Research should neither undertake nor drop projects without consulting Administration, at least in those localities where the projects were likely to have application.

The most general feeling was one of dissatisfaction in the way Research makes its results available. The undesirability of providing means through a partial exposition whereby some people might mis-apply results to their own temporary advantage was mentioned. The general feeling was that Research holds its findings too long until it has enough material for a formal publication. I pointed out that current results are issued each year in the Station's Annual Report; but this, they said, is usually not read because it is "too much all at once." One supervisor said that he took the time last year to read the Annual Report and was pleasantly surprised to find that it had "a lot of good stuff hidden in it." Short technical notes as issued by some other experiment stations were thought to be more satisfactory.

I believe this criticism is particularly important because all the men seemed to feel so strongly about it. It is not sufficient to debate whether the supervisors are at fault for not digging through our Annual Report or whether we are for preparing the kind of report we do. The fact is — if this group is representative — that our Annual Report isn't getting read. Two losses result: On one hand the information isn't being disseminated and put into practice to the extent that it should be. On the other hand, the considerable effort we devote to preparing the report might perhaps be directed more effectively into other channels.

Provision of information: basic knowledge

I have long believed that one of the principal objectives of Research is to widen our comprehension of fundamentals. Fundamental studies are commonly criticized because their application may not be obvious at the moment; yet in the long run it is fundamental knowledge rather than some specific application-knowledge which we must draw upon for working tools.

My conviction was repeatedly confirmed by events on the trip. The use of type writeup sheets has already been described (pp. 6-10). Many times, although we could see that evident changes had taken place over the years, we still were unable to interpret them. Some had fairly obvious connections with grazing, but others might or might not have had, for all we could tell. We needed to know what these changes meant before we could prescribe remedial measures, and in fact before we could really judge the condition of the range. But to interpret these changes we needed to know a good deal more about the structure and functioning of these plant communities than anybody knows at present.

In considering range conditions allusion to vegetal succession was made time and time again. The succession concept was a reference point in the group's thinking, a base from which nearly all judgments were finally made. It is, in fact, impossible to consider the application of range management otherwise, at least at the present stage of ecological knowledge. Here too, however, we were unable to proceed very far toward conclusions because of the scarcity of reliable information on this fundamental process. On account of this lack the group

was forced to go pretty far afield for information that might be applied to particular problems, and a number of times someone went so far afield that the information he tried to apply was inappropriate to the problem. In this paragraph and the last, then, I mean to point up the fact that one job Research should devote itself to is the prosecution of fundamental ecological studies.

Similar fundamental studies on the nature of the soil-building process and the soil-destroying process are badly needed, particularly with reference to the multifarious variations in physical factors and the many types of vegetal cover existing on mountain range. Something of this sort has already been referred to in the section "Relationships between grazing and range recovery." In this connection I wonder if a great deal of good information may not be gathered by inspectional methods over a wide area and be put to use quickly while some of the Station's elaborate experimental setups are getting under way? I appreciate the fact that costly apparatus has been installed because there are some questions which cannot be answered without it, but I feel fairly confident that some of the information we need can be gotten otherwise. In saying this I reason mostly from analogy with ecological problems -- the processes of soil formation and loss are also ecological -- some of which will ultimately be solved only by detailed experiment, but many of which may, for the time being, be solved by simpler means.

We already have a good deal of raw data available, and some of it has been worked up, as to the life span of various species of range plants. We can probably also arrive at some values from the same data which will indicate how long dead tufts and stems persist.

It may be possible to correlate size of plants with age, although so far I have had little success except with shrubby species. It may also be possible to arrive at some usable indicators which would give an approximate idea of the rate of soil erosion in years. Such quantitative measures as these, even though they may be exceedingly rough, are badly needed by range managers to serve as clues which will give a numerical notion in terms of years as to what has taken place on the range; and, for that matter, they are badly needed by Research itself in studying range ecology. It would have been a great help if we had had a fund of such knowledge to draw upon during the trip. Lacking it, we were obliged to guess.

Provision of information: practical studies

Perhaps the last paragraph has bridged the gap -- and it is but a slight one -- between fundamental and "practical" studies. By practical problems I am thinking of those concerned directly with range management which require immediate solutions. The degree of precision required is not great; rule-of-thumb answers will be sufficient so long as they give land managers reasonably sound guidance. Any guidance with a scientific basis will certainly be better than no help at all.

The first problem I would list is a broad one: when is the range sufficiently improved so that more stock may be allowed on? The question was brought up for discussion from the standpoint of policy, and the point was made that if the range were definitely recovering, the Forest Service should not lag behind the trend and have to be forced into restoring cuts. Many people now have the

Fig. 14.- Heavily grazed bottom in Montpelier Creek. Note how willows have been trimmed by cattle. L.E. 660

idea that the Forest Service is in a groove where it can think of nothing but reductions, that we are not sincere in the concept of grazing the range to its safe maximum capacity. Hence, if we fail to take the initiative when range conditions improve, this mistaken idea will become even more widely prevalent.

Because of good rainfall generally over the West in 1941 there has been an excellent showing of vegetation, and I myself have heard of at least two groups of responsible inspectors enthusiastically suggesting that more stock be put on the ranges. Now it may be that more stock should be allowed on, but I don't believe

one year's forage growth is a sufficient basis for making so important a decision. And if we should have a series of good years subsequent to 1941, I can imagine that the pressure will become very great, even though the range may have actually improved but little. True range recovery involves rehabilitation of the soil and of the micro-environment at the soil surface: such rehabilitation is not to be accomplished in a single year nor in a short span of years, even though favorable rainfall may cause the vigor of forage plants to be very high.

Thus the administrative branch of the Service is in something of a fix unless it can get more facts upon which its policy may be moulded. If range conditions are really improving, what are the basic, factual criteria which tell us so? Are they sufficiently well founded that we feel certain we can best discharge our responsibility for the welfare of the public's range by increasing the grazing use? On the other hand, if the degree of improvement is only apparent and not what it seems to be, what criteria have we by which we may know this fact and convince the public of the true state of affairs?

The second practical problem I would list is one that concerns the Caribou acutely, but undoubtedly knowledge of the proper solution would find some application on all mountain ranges.

At the southern end of the Caribou the hills are high and slopes are steep. The fact that local economics depend on cattle rather than sheep requires that for some time to come the range must be grazed by stock to which it is not adapted. The bottoms have been heavily overgrazed for years by cattle while the slopes have gone

practically unutilized. To obtain more even utilization the Forest has fenced out the bottoms and foot slopes, thus forcing the cattle to graze the upper slopes and ridges, and springs have been developed to make this feasible. The bottoms are grazed only in the fall, and under this treatment they have shown marked improvement in but a few years.

The essential problem is this: what degree of use will the slopes withstand as compared with the bottoms? We know the slopes cannot withstand as heavy use as the bottoms because the slope soil is less stable; but specifically, can they withstand half as much, a tenth as much, a hundredth as much, or a thousandth as much use?

Suppose, for example, that it is decided to reduce grazing use of the bottoms by 50 percent, which presumably will permit the bottomland range to maintain and improve itself. The stock removed from the bottoms are to be distributed over an area of slopes and ridges 20 times as great as the area of bottomland. Let us assume, also, that the resulting distribution is perfectly uniform. The tacit assumption here is that the resistance of the slopes and ridges is no less than one-twentieth the resistance of the bottoms. If this be true, all is well; if, however, the relative resistance is only one one-hundredth, then the solution through distribution is no solution. Indeed, it is a grave mistake, for while depletion of the bottoms may be likened to the first ball analogy (pp. 18-19), not a very serious problem, depletion of the slopes will most probably be like the second, and we may well have started something which cannot be stopped without great cost.

Here is a place where research is urgently needed. Lacking facts, even the roughest of rule-of-thumb measures, Administration is forced to do its own experimenting by a cut-and-try process which may easily turn out to be very costly.

Provision of technical assistance

Beside assisting Administration with such technical problems as may be involved in range reseeding and upstream engineering by means of contour furrows, Research can supply material help in other ways. One is by consultation in choosing sites for administrative enclosures and study plots. Such assistance can be of more value than it might have been in the past, since administrative policy is now to construct much larger -- and hence more costly -- enclosures than heretofore. No great loss may have been incurred when an enclosure of four square rods was improperly located, but if an unsuitable area of four acres is fenced, the loss will be considerable. One cardinal principle in the construction of enclosures has already been adopted by Administration, to make them sizeable. Another is to select them so that the influence of outside conditions does not dominate the environment inside -- so that run-off from the outside range does not wash over the surface enclosed, for example. Another is to establish at least one thoroughly comparable area outside. This, the determination of comparability, requires a great deal of skill which only a specialist may be assumed to possess. A specialist may still make plenty of mistakes, but doubtless fewer than a person without his experience.

Fig. 15.- A drainage of about two acres in lower Fall which has been heavily overgrazed. The soil and rock in the foreground were derived from the washing of this one small drainage. This drainage might prove to be a suitable area for enclosure: while representing a serious problem it is self-contained, probably there are similar nearby drainages for comparison, and fencing would not be excessively expensive. L.E. 686

There is one aspect of what might be called extension which should be mentioned here. This would consist of the preparation of exhibits describing important ecological phenomena, and posting them along routes of travel at places where the phenomena are fairly obvious once they are pointed out. The emphasis, as I conceive it, need not be on management at all, but simply on facts, with the purpose of increasing the knowledge of ecology among forest officers and the public. The spread of conifers as illustrated in Fig. 9 is an example of the kind of thing I mean. The interest shown by the group when they appreciated clearly what was taking place on this slope was gratifying. I believe this interest was stimulated fully as much by the realization that the apparently stable vegetation was actually dynamic as by the change itself.

Exhibits have been prepared to highlight the cultural work on the Davis County watershed, and they are used in explaining the results of artificial reseeding trials. These exhibits have a moral, they point out ways in which man is coping with nature. What I have in mind is similar, but without a moral as often as with one -- without one as long as we are unable to ascribe definite causes, with one when we are able. The increased appreciation of ecological problems and processes among nontechnical people should aid materially in the adoption of ecological principles of management as they are developed.

Encouragement of desirable attitudes

I have long contended that one of the aims of scientific men, as a sort of by-product of their existence, should be to further the adoption of the scientific attitude generally. By this I do not mean that scientists are somehow superior to their fellow men — they seem to have about an average stock of virtues and faults, as a matter of fact — but that there is a scientific ideal which in their best moments some manage to live up to, of disinterestedness, objectivity, and wholesome skepticism; and that this is worthy of wider application. The scientific attitude is not something we can teach, but people will appreciate what it is if we try to live it.

Some of the principles of a critical appraisal, however, are not beyond description. I am thinking particularly of the problem of getting "a representative cross-section" which is so often taken for granted with any kind of sampling. I pointed out near the beginning of this report that we did not sample the entire Caribou representatively because the rougher parts are not accessible by car. I believe it is possible to go farther and demonstrate biased sampling of the country actually accessible to us. The following tabulation shows

	September						Totals
	1	2	3	4	5	6	
Creek bottom or draw	6	4	3	2	1	1	17
Gentle slope	4	1	5	3	3	1	17
Steep slope	3					1	4
Ridge top	1			2	4	1	8
Total number stops	7	4	5	3	4	1	24

that of seven stops made by the party for purposes of range inspection September 1, only one included a visit to a ridge top and only three to steep slopes. When the road followed a ridge as on September 5 when four stops were made, the sampling still did not include the steepest slopes.

I am not suggesting that the party deliberately avoided some parts of the range. Actually a number of causes were responsible for the course the party took -- probably the most important was the human tendency to pick the route where travel is least difficult. What I would like to point out is that no precautions were taken against such sources of bias, nor were they mentioned by anyone, so I conclude that they were not generally recognized. If this conclusion be true, it follows that range inspection generally, from that done by the ranger to that done by the integrating inspectors from Washington, is subject to the same kinds of bias. In that case a more widespread appreciation for the principles of sampling would increase the value of range inspection considerably. One has only to remember the utterly wrong election prediction made by the Literary Digest straw vote in 1932, as compared with the close Gallup estimate, to appreciate the fact that <u>not only must every condition be sampled, but it must be sampled in proportion to the frequency of its occurrence</u>.

WAYS IN WHICH RESEARCH CAN PROFIT BY CLOSER COLLABORATION WITH ADMINISTRATION

Utilization of information from old study plots

A number of quadrats were laid out on the Caribou in 1913 or 1914, some of which were recharted about 1922. The markers of some, if not of all of these, may have disappeared by now. The party did not attempt to relocate any. I suppose that from time to time quadrats and plots of various kinds have been established throughout the Region by forests or regional office men, and as time has passed and personnel has shifted, the collection of records has been discontinued. If a systematic search were to be made for the old records in the files and for the plots in the field, it may be imagined that changes in the vegetation, of value to range management and ecological science alike, might be made out. The matching of old photographs is sometimes helpful also.

I believe the Station should look further into the possibility of salvaging information in this way. One great benefit to a project devoted to the study of such old plots is that, rather than spend all his time in a restricted locality, the range ecologist would have his experience broadened among a wider variety of sites and types. It is difficult to state explicitly the value of this broadened experience. The ecologist may be likened to a wire lying in a magnetic field. So long as the wire is still, nothing much may be expected to happen; but when it is moved across the field a current is immediately induced. In an analogous way movement among a variety of conditions and places stimulates creative thought.

Fig. 16.- Looking west up Tincup Creek from hillside above Pine Bar. Vegetation on south-facing slopes (right) is sagebrush, with aspens in the hollows; that on north-facing slopes is conifer forest. A stock driveway runs along the lowest north-facing slopes, against the creek. Note that the more densely vegetated north-facing slopes are steeper than the south-facing slopes. This illustrates an important relationship between exposure, vegetation, and physiography. L.E. 669

Moreover, I think we should not overlook the chances for utilizing past range surveys in studying range ecology. Their utilization on this trip and on the Manti has already been described (pp. 6-10). If used wisely, with due allowance for their shortcomings, there is every reason to think these old surveys can be made to yield many important facts. Certainly they represent a rich fund of information, the like of which, so far as I know, is to be found nowhere else in the world. In considering a project

for utilizing these records, two precautions should be observed: one should not attempt to detect changes after too short an interval has elapsed; and one should not suppose that, because the data are all down on paper, he can go out in a short time and harvest the facts as he would harvest plums. Actually a great deal of time is needed to evaluate present conditions accurately, to interpret the old writeups correctly, and to draw sound conclusions as to the changes that have occurred and the reasons for them.

Planned experiments

The installation of pastures by Research, to be grazed in various ways, is one method for arriving at improvement in grazing practice. It has been quite successful as applied to lowland range where topography and vegetal types are maximally uniform, but to date the method has not been proved successful on mountain range with its extremes of site and cover. Because a pasture experiment is costly, and applicable, when all is said, over no very great diversity of mountain range, we should not adopt this method until all other possible methods are inquired into.

The method of general observation or ecological reconnaissance is one, and it is much used by ecologists everywhere. The method of utilizing plot records and range survey data, as described in the last section, is another. Either of these methods might be supplemented by short-term experiments, in which certain problems are attacked by a quasi-laboratory technic; this could be called a third method. The experiments by Sampson on water requirements, on plant vigor, and on aspen reproduction are examples of use of the third method.

Still a fourth method, approaching the method of controlled grazing on pastures, would be to utilize the adjustments made by Administration in order to study the reactions of vegetation and soil. Suppose, to take the simplest example, we were interested in a piece of range about which we had a good deal of knowledge gained from general observation and the study of old records. Suppose, further, that the decision is reached to make a radical change in management on half this piece of range, but to continue current practices on the other half. Then, if we could be assured that the revised plans would stay in effect for a sufficiently long period, we would be in a good position to measure the effects of the change in management,

Fig. 17.- Sheep grazing near Brockman R. S., Stalworthy Allotment. L.E. 676

just as though we were working with pastures under controlled grazing. In this way we might be able to pick bits of range throughout the Region where Research and Administration could cooperate to the advantage of both. Such a procedure would require a sort of master plan so that a suitable series of treatment differences could be arranged for; and it would require a working agreement so that both parties, from the head men down to the field workers, would know precisely what treatments were to be under consideration, when and how they were to be changed, and how long the study would continue.

I have illustrated the fourth method by an example. The example itself may not be a very good one, but the general principle of the method is, in my opinion, worthy of the most serious consideration. Obviously Research would not have the freedom that it would have with pasture experiments under its sole direction; nor would Administration have the same freedom as if Research had not come in. There is an element of disadvantage to both parties in this restriction of freedom. On the other hand, there is this advantage, that Research would be getting its teeth into some of the problems that beset Administration most sorely; and it is to be hoped that this would outweigh the element of disadvantage many times.

Orientation

I have often heard the phrase "orientation of Research effort in line with Administrative needs," but I never appreciated its meaning so fully as I have since this Caribou trip. If there are many Research men who are as limited in this respect as I have been, they should by all means be given the opportunity for such contacts.

Whether Research effort is properly oriented might be debated at length. I think it may be said conservatively that in some respects, at least, it is not properly oriented. This conclusion should follow from pure rationalization, for we know that, in a world characterized by change, yesterday's goals cannot be just the same as today's. Hence our Research objectives need to be overhauled periodically and examined critically in the light of current conditions. To make this overhauling pay, the whole field of current and probable future administrative needs must be appreciated to the fullest extent possible. And in resulting plans, the variety of conditions to be encountered in the field, and the appropriate order of magnitude of accuracy in experimental results should be thoroughly comprehended.

ROUTE OF SUPERVISORS' TRAINING-INSPECTION TRIP, CARIBOU N. F.

August 30 to September 6, 1941

——— Main party, Sept. 1-6.

- - - - Preliminary coverage, Aug. 30-31.

111°30′ 20′ 10′ 111°00′ 110°50′

43° 40′ 43° 30′ 20′ 10′ 43° 00′ 42° 30′ 42° 20′ 50′

R.42E. R.43E. R.44E. R.45E. R.46E. R.118W. R.117W. R.120W. R.119W.

T.3N. T.2N. T.1N. T.1S. T.38N. T.37N. T.36N. T.35N. T.34N. T.33N. T.32N. T.31N. T.30N. T.29N. T.28N. T.27N.

ANTELOPE FLAT

TARGHEE

NATL. FOREST

PHILLIPS BASIN

MAHOGANY RIDGE

FOURTH OF JULY RIDGE

HOME RIDGE

COMMISSARY RIDGE

GOLDEN GATE RIDGE

CASTLE ROCK RIDGE

CARIBOU BASIN

GRAYS LAKE

TINCUP RANGE

BLACK MTN.

IDAHO WYOMING

SALT RIVER RANGE

GANNETT HILLS

CASTLE HILLS

SUBLETTE RIDGE

SNAKE RIVER CANYON

GRAND VALLEY

SWAN VALLEY

DRY VALLEY

SAGE VALLEY

LONG VALLEY

DRY RIDGE

BLACKFOOT RIVER VALLEY

WOOLEY VALLEY

ENOCH VALLEY

NOUNAN VALLEY

BEAR RIVER VALLEY

Mud Cr. RIVER

ANTELOPE FLAT

Little Pine Cr.

Antelope Cr.

Granite Cr.

Lyon CONANT VALLEY

RESERVOIR

Ballys Hole

Nelson Cr.

Garden Cr.

Long Canyon Cr.

Mt. Baldy 7380

Dry Hol.

Pt. Lookout

Porcupine Cr.

Blacktail Can.

Bates Can.

Cr. FALL CR. G.S. 5898

Monument Cr.

Camp Cr.

Haskins Cr.

FALL CR. BASIN

Fall Cr.

Rash Can.

Pine Cr.

Beaver Cr.

Dume Cr.

Castle Rock 7004

Lava Cr.

Corral Cr.

Sawmill Cr.

Golden Gate

Chepereau Hot.

White Spr.

Brockman Creek

BROCKMAN G.S.

Hot Spr.

Outlet Creek

Shirley Cr.

Pole Cr.

Spring Cr.

Clark Cr.

Herman 6605

HERMAN G.S.

Delle Basin

Barnes Cr.

Miners Delight Camp

CARIBOU BASIN G.S.

Anderson Gul.

Bilk Cr.

Taylor Cr.

Caribou City

Caribou Mtn.

Gray

Bear L. 6660

LAKE

RESVR.

LITTLE VALLEY

HILLS

Bishop L.

Morgan Mdw.

GRAYS LAKE 6430

GRAYS LAKE G.S.

Eagle Cr.

Bridger Cr.

Tincup Mtn. 8215

Chubb Springs

Camp Pk. 7729

Pelican Slough

Wayan

Williamsburg

MIDDLE DAIRY

LANES GRAVE

LANES CR G.S.

UPPER DAIRY

LOWER DAIRY

Henry

Henry 8320

Stump Pk. 8600

Diamond Flat

South Fk. Snake R.

Alpine Hot Spr.

Alpine 5570

Ferry Pk. 9598

Bitters Pk. 7190

BALD MT. G.S.

Old Baldy Pk. 8330

Burns Fk.

LOWER BLACK

King Miller Cr.

Deep Cr.

Pat Can.

Squaw Cr.

SQUAW CR. SAWMILL

Lightswander Canyon

Black Skull Can.

Skull Can.

Cabin Cr.

Jackknife Cr.

Etna

ETNA GUARD STATION

GLO POST NO. B

Prater Mtn. STAR 10105

Star Pks

Prater Cr.

Green Cr.

Cedar Cr.

Fork

Freedom

FREEDOM R.S.

Scheiss Cr.

Old Mans Rd.

Grouse Cr.

Deer Cr.

Little Star 6783

Thayne 6192

Bedford 6269

BEDFORD R.S.

BEDFORD CH. SP.

Strawberry Cr. 6221

Beard Can.

Smith Fk.

Lost Cr.

Dry Cr.

Limekiln Cr.

Swab Cr.

Miller Fk.

Crooked Cr.

Brush Cr.

Willow Cr.

Alfred Can.

Jensen Can.

Water Can.

West Peak

Hyde Can.

Tyde Cr.

Bachler Cr.

Diamond Pk. DEAD TREE

Horse Cr.

Cow Cr.

Chicken Spr.

Cabin Cr.

Yellowjacket Cr.

Stump Cr. G.S.

OLD SALT WORKS

Stump

8th Std.

Auburn

Grover

Par. N.

Phillips Can.

Jensen Can.

Blaney Can.

Anderson Can.

Lily Hot

Red Hol.

Swift Cr.

Scout Cr.

Graveyard Can.

Hale Can.

Elbow Can.

Twin Hol.

Dry Cr.

Basset Cr.

Mud Hol.

Wickiup Knoll

Spring Can.

Dry Cr.

Smoot

Cottonwood Cr.

Willow Cr.

Second Cr.

First Cr.

Spring Cr.

Gannett Cr.

Camel Hollow

Pine Cr.

Rock Cr.

Dip Cr.

The Pinnacle 8354

N. Fk. Fish Cr.

Little Fish Cr.

Fish Cr.

Little White Cr.

Lost Cr.

Robinson Cr.

Water Can.

7th Std. Par. N.

Salt Basin

Greaffe Cr.

Salt Dipper Cr.

Geneva

Thomas Fork

Muddy Cr.

Little Muddy Cr.

Raymond

Covey & Blaney Ranch

Mumford R.

Sheep Cr. Resvr.

Wardboro

Sheep Cr.

Robinson Cr.

Meade Pk. 9953

Preuss Creek

Mountain Dip Cr.

Dry Cr.

Beaver Cr.

Halfway House

Beaver Dam

Snowdrift Mtn.

Bear Lake Caribou Co.

Sand Wash

Clear Cr.

White Pine Cr.

Loop Cr.

Hoopes Spr.

Big Spr.

Geo Gates Spr.

Phosphate Gulch

Phosphate Trail

Red Pine Spr.

The Hole

Big Can.

Rattlesnake Can.

Cranes Resvr.

Fossil Gulch

Dry Fk.

Jones Can.

Harrington Pk. 8554

Cold Spr.

Deer Creek

Deer Creek Spr.

Thess Spr. No. 1

Thess Spr. No. 2

Green Mtn. 8777

Wilde R.

The Ponds

Wilde Can.

Swan Lake

Ice Cave

Rose

Soda Springs

Strachan

Sulphur Pk. 8316

Sulphur Can.

Meadow Spr.

Lake Gulch

Diamond Gulch

Johnson

Petterson Can.

PETTERSON R.

DRY VALLEY G.S.

UPPER DRY

Freemen Pass

Hill Spr.

Sage Valley Creek

SAGE VALLEY R.

Buck Mtn. 7608

Sprague Cr.

Spring Can.

Dry Cr.

Wiley Cr.

Manning Cr.

Tolman R.

Rock Cr.

Brown Cr.

Willow Cr.

Second Cr.

First Cr.

Gannett Cr.

Camel Hollow

Pine Cr.

Rock Cr.

Dip Cr.

Third Cr.

Gamm Cr.

Christopherson Cr.

Cedar Cr.

N. Fk. Fish Cr.

Little Fish Cr.

Fish Cr.

Little White Cr.

Lost Cr.

Robinson Cr.

Water Can.

Manson

Eightmile G.S.

Eightmile Cr.

Ninemile Cr.

Pearl Cr.

Cavanaugh North Hill 6787

Nounan Valley

Nounan Cr.

Nounan River

Novene

Nounan

Georgetown

BEAR VALLEY BASE

W. END

E. END

Lit. Three Mile Can.

Rowley Can.

Wooleys

Threemile

Sherman Pk. 9669

Soda Co-op

Meadow View G.S.

Stauffer

Pine Cr.

Maple Can.

Bald Mtn. 9251

Pascadero

Bennington

Cart Hollow

Joes Gap

Fox Spr.

Hengel R.

Snowslide Can.

Givequt

Geneva

Sublette Ridge

Bear River Valley

Pacific Creek

Emigration Can.

Pole Can.

Copenhagen Can.

North Can.

Sharon

Bern Par.

Copenhagen Basin

Liberty

Montpelier

MONTPELIER R.S.

South Elbow G.S.

Montpelier City Resvr.

Phosphate Mines

Hell Hole

Willow Spr.

Bear Hollow

Dry Green Pass

Midnight Mtn.

Midnight L.

Green Basin G.S.

Lanark

Ovid

Miles Can.

Bear Lake Outlet

Bear River

Wardboro

Sheep Cr. Resvr.

Bear Lake Co.

Bannock Co.

Caribou Co.

Lincoln Co.

Bingham Co.

Bonneville Co.

Teton Co.

Lincoln Co. Observation Pk.

Red Wolf Mtn.

Dog Pass

Indian Pk. 9681

Red Mtn. 9791

Bradley Mtn. 9295

Elk Pk. 8505

Fork of Grays Lit. Grays River G.S.

Grays River

Stewart Pk. 10080

Murphy Lks.

Murphy Pk.

Star Pks 10039

Observation Pk. 9977

Indian Cr.

Dry Cr.

Cabin Cr.

Elk Cr.

Little Elk

Needle Pk. 9445

Quaker Flat

Rosa Hill

Mt. Hill 5436

Foot Bridge

Red Pk. 8750

Yeaman Cr.

Congress Knob

Russell Cr.

Alder Cr.

Pt. Hill Rx

Lit. Sheep Cr.

Sheep Cr. Pk. 9940

Elkhorn Pks

Mt. Baird 10040

Austin Cabin Cr.

Sheep Cr.

Dry Can.

Hells Hole

Elk Cr.

Paul Pk. 9774

Paul Pk Run

Blowout Can.

Blowout

Lack Bail Spr.

Edwards Ferry 5506

Edwards R.

Edwards Cr.

Poker Pk. 8435

Big Elk Mtn. 9478

Little Elk Mtn. 8745

Sulphur Cr.

Williams Cr.

Jensen Meadow

Grand Valley

Alpine Hot Spr.

Alpine 5570

Ferry Pk. 9598

Bitters Pk. 7190

Sanders R.

Bar Canyon Cr.

McCoy Cr.

Kirk Cr.

Fish Cr.

Trout Cr.

Black Mtn.

Old Baldy Pk. 8330

Comb Cr.

Burns Fk.

Lower Black

King Miller Cr.

Deep Cr.

Pat Can.

Squaw Cr.

Squaw Cr. Sawmill

Lightswander Canyon

Black Skull Can.

Skull Can.

Cabin Cr.

Jackknife Cr.

Etna

Etna Guard Station

GLO Post No. B

Prater Mtn. Star 10105

Star Pks

Prater Cr.

Green Cr.

Cedar Cr.

Fork

Freedom

Freedom R.S.

Scheiss Cr.

Old Mans Rd.

Grouse Cr.

Deer Cr.

Little Star 6783

Thayne 6192

Bedford 6269

Bedford R.S.

Bedford Ch. Sp.

Strawberry Cr. 6221

Beard Can.

Smith Fk.

Lost Cr.

Dry Cr.

Limekiln Cr.

Swab Cr.

Miller Fk.

Crooked Cr.

Brush Cr.

Willow Cr.

Alfred Can.

Jensen Can.

Water Can.

West Peak

Hyde Can.

Tyde Cr.

Bachler Cr.

Diamond Pk. Dead Tree

Horse Cr.

Cow Cr.

Chicken Spr.

Cabin Cr.

Yellowjacket Cr.

Stump Cr. G.S.

Old Salt Works

Stump

8th Std.

Auburn

Grover

Par. N.

Phillips Can.

Jensen Can.

Blaney Can.

Anderson Can.

Lily Hot

Red Hol.

Swift Cr.

Scout Cr.

Graveyard Can.

Hale Can.

Elbow Can.

Twin Hol.

Dry Cr.

Basset Cr.

Mud Hol.

Wickiup Knoll

Spring Can.

Dry Cr.

Smoot

Cottonwood Cr.

Willow Cr.

Second Cr.

First Cr.

Gannett Cr.

Camel Hollow

Pine Cr.

Rock Cr.

Dip Cr.

Third Cr.

Gamm Cr.

Christopherson Cr.

Cedar Cr.

N. Fk. Fish Cr.

Little Fish Cr.

Fish Cr.

Little White Cr.

Lost Cr.

Robinson Cr.

Water Can.

7th Std. Par. N.

Salt Basin

Greaffe Cr.

Salt Dipper Cr.

Geneva

Thomas Fork

Muddy Cr.

Little Muddy Cr.

Raymond

Covey & Blaney Ranch

Mumford R.

Sheep Cr. Resvr.

Wardboro

Sheep Cr.

Robinson Cr.

Meade Pk. 9953

Preuss Creek

Mountain Dip Cr.

Dry Cr.

Beaver Cr.

Halfway House

Beaver Dam

Snowdrift Mtn.

Bear Lake Caribou Co.

Sand Wash

Clear Cr.

White Pine Cr.

Loop Cr.

Hoopes Spr.

Big Spr.

Geo Gates Spr.

Phosphate Gulch

Phosphate Trail

Red Pine Spr.

The Hole

Big Can.

Rattlesnake Can.

Cranes Resvr.

Fossil Gulch

Dry Fk.

Jones Can.

Harrington Pk. 8554

Cold Spr.

Deer Creek

Deer Creek Spr.

Thess Spr. No. 1

Thess Spr. No. 2

Green Mtn. 8777

Wilde R.

The Ponds

Wilde Can.

Swan Lake

Ice Cave

Rose

Soda Springs

Strachan

Sulphur Pk. 8316

Sulphur Can.

Meadow Spr.

Lake Gulch

Diamond Gulch

Johnson

Petterson Can.

Petterson R.

Dry Valley G.S.

Upper Dry

Freemen Pass

Hill Spr.

Sage Valley Creek

Sage Valley R.

Buck Mtn. 7608

Sprague Cr.

Spring Can.

Dry Cr.

Wiley Cr.

Manning Cr.

Tolman R.

Rock Cr.

Brown Cr.

Willow Cr.

Second Cr.

First Cr.

Gannett Cr.

Camel Hollow

Pine Cr.

Rock Cr.

Dip Cr.

Third Cr.

Gamm Cr.

Christopherson Cr.

Cedar Cr.

N. Fk. Fish Cr.

Little Fish Cr.

Fish Cr.

Little White Cr.

Lost Cr.

Robinson Cr.

Water Can.

Manson

Eightmile G.S.

Eightmile Cr.

Ninemile Cr.

Pearl Cr.

Cavanaugh North Hill 6787

Nounan Valley

Nounan Cr.

Nounan River

Novene

Nounan

Georgetown

Bear Valley Base

W. End

E. End

Lit. Three Mile Can.

Rowley Can.

Wooleys

Threemile

Sherman Pk. 9669

Soda Co-op

Meadow View G.S.

Stauffer

Pine Cr.

Maple Can.

Bald Mtn. 9251

Pascadero

Bennington

Cart Hollow

Joes Gap

Fox Spr.

Hengel R.

Snowslide Can.

Givequt

Geneva

Sublette Ridge

Bear River Valley

Pacific Creek

Emigration Can.

Pole Can.

Copenhagen Can.

North Can.

Sharon

Bern Par.

Copenhagen Basin

Liberty

Montpelier

Montpelier R.S.

South Elbow G.S.

Montpelier City Resvr.

Phosphate Mines

Hell Hole

Willow Spr.

Bear Hollow

Dry Green Pass

Midnight Mtn.

Midnight L.

Green Basin G.S.

Lanark

Ovid

Miles Can.

Bear Lake Outlet

Bear River

Wardboro

Sheep Cr. Resvr.

Bear Lake Co.

Bannock Co.

Caribou Co.

Lincoln Co.

Bingham Co.

Bonneville Co.

Teton Co.

POLYCONIC PROJECTION
NORTH AMERICAN DATUM